Texas Star Party

Telescope Check Using Resolution Target - *SCURT*

What it's all about?

- We all haul our telescopes to TSP hoping for a good week's observing, but how well does our equipment travel?
- Why does your neighbour's scope seem to be working better than yours? (or vice versa!)
- That eyepiece you have just borrowed or purchased seems to work well, but how much better is it really?
- Perhaps our scopes are fine, it's just that another year older, our eyes are showing their age?
- Last year 28 observers shared their results and a very interesting analysis was published in the Oct/Nov 2013 issue of **Astronomy Technology Today**. You can download the article from the "Real Science with SCURT" page on the TSP website.

Repeating last year set up we have resurrected a feature last seen at TSP in the early 80's – this time snappily named SCURT, (Scope Check Using Resolution Target).

Mounted on the top of the hill directly to the east of the ranch, it will allow observers to accurately measure the resolving power of their telescopes, at any time during the night.

The resolution target includes horizontal and vertical 3 bar patterns representing angular separations from a generous 4 arcsec, way down to an unbelievable 0.08 arcsec.

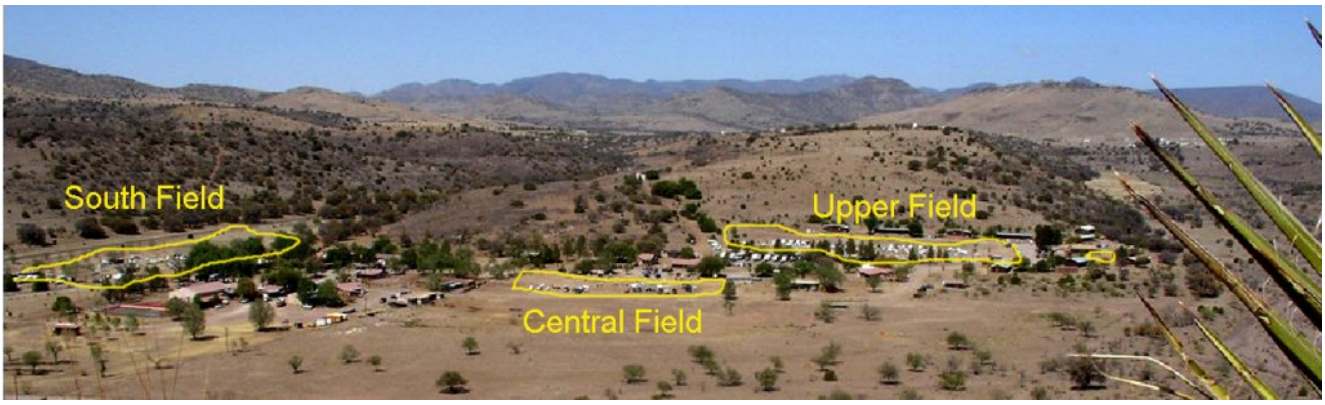
They are illuminated by white LEDs which will be switched on at dusk. This year we can even do some useful observing if it is cloudy!

How to use the SCURT - Setting up

Firstly, you will clearly (pun intended!) need to position your telescope where you will be able to see the target! The target will be in position before you get to TSP, so you just need to check you have a line of sight as you position your scope on arrival.

The photo below, taken from the target position will give you some idea of visibility from the three main observing fields at TSP. The Central field will be the clearest, but the Upper and South fields will generally provide unobstructed views if a few trees are avoided.

Don’t worry about the different distances to the target and the change of viewing angle, we have prepared conversion tables specific to each field. We even have one for the astro-imagers who might want to set up behind the lodge building.



Using SCURT

First do what ever set-up and collimation you normally do first.

Take a look at the SCURT when your scope has cooled down nicely, and the air turbulence across to the target has settled down. This will probably be at least an hour after sunset.

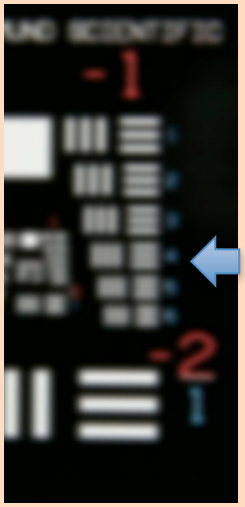
Using the highest power you are normally comfortable with, make sure you are at best focus and look at the target. (Make sure your RA drive is turned off!)

Now for the measurement! Look for the smallest bar patterns that you can just see as being three bars, and not one square one. An example of what is, and isnt resolved is shown below.

The image here shows what a section of the target should look like through a scope where the limiting resolution of the scope has caused the bar targets to be blurred. We can see that target elements at the top of Group -1 can be easily resolved into bars, but those at the bottom cannot.

The target element that best meets the “resolved” criteria is number 4, (4th from the top). This is the smallest target that even if you didn’t know, you would still say it had three bars. You don’t have to be able to be able to see the three bars clearly, just know they are there.

Remember, your view will probably be inverted in one or both directions.



It may be that you can resolve better in either horizontal or vertical bars, this is common and we will see why later. Try different powers and/or eyepiece types to make sure you are squeezing the most resolving power you can out of your scope.

Having decided which bars you can resolve, you need to work out their target number(s). This won't be obvious as the numbers on the target will be fuzzy and may not be legible. On page 5 of this note is a *SCURT Target sheet* which shows the whole target, but of course depending on your type of scope the image may be inverted in one or both axes. First identify which Group of bar targets you are looking at, and their number will be in red. Note that some of the Groups of small

targets in the centre region have the largest target element separated, (it has been like this 1951 when the USAF first laid out the design of the pattern!) Study the chart at the back of this paper and you will soon see how it works. Having found the Group number you are looking at, identify which target element you can just resolve in each of horizontal and vertical, these element numbers are in blue. Now using the appropriate look up table on the *SCURT Target sheet* for your observing field convert these numbers into resolution in arc seconds.

Now record your measurements in the first column of the record table, either on the spreadsheet or the paper version on page 6 of this note. It would be really good if you could get some other observers to repeat the measurement on your scope. The record table has space for up to 4 sets of measurements, but just one extra will help a lot.

If your scope is of the type that can be collimated, now is the time to see if it can be improved! (only do this if you feel confident in what you are doing, we don't want a field full of wonky refractors!) Repeat the whole measurement, including other observers, after tweaking your collimation, or at any time during the week. Just be sure to write down your results on the table together with a short note about what you changed.

Results entry and feedback

We want to start feeding back the results as early in the week as possible, so please submit your measurements as soon as you have some. You can always add more results later in the week.

Any paper results can be passed to me at my scope in the middle of the Centre Field or at Cabin 6, (I will make a copy so that you can keep your results sheet. Summaries of results will be posted on the notice boards by the meal queue as soon as they are available, but they wont identify individual observers or scopes.

Using the results

This table gives an idea of the resolving power for different aperture scopes. These are based on separating two close stars (Dawes Limit), and it is probably that for our bar targets you could see even better, (perhaps around twice). However there are many factors that can effect measurements and so we want you to let us know your results and we will analyse them all and feedback the whole picture. Dont worry, individual results will remain anonymous!

Scope aperture		Resolution Limit [arcsec] *Approximate*
4"	100mm	1.1
8"	200mm	0.7
12"	300mm	0.4
18"	460mm	0.3
24"	600mm	0.2

This is where it gets exciting and useful! Your own results should be useful to you on their own, plus we can group together results for similar telescope classes, for instance 4" refractors, 8"SCT, or 18" dobs.

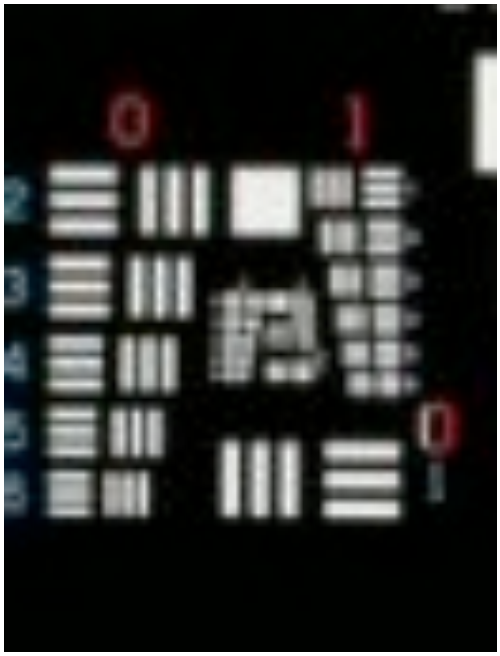
Results we should get are;

- Did checking collimation help much? If so by how much?
- How do you compare with other observers on the same scope? This comes down to judgement of what is resolved or not, and eyesight.
- Do you have a big difference between horizontal & vertical resolution even after checking collimation? This may be due to a poor diagonal mirror or astigmatism in your objective or your eyesight.
- How well does your scope compare with others in the same class? If it is significantly worse, then how about getting some help or at least a second opinion!

The Overall TSP results will be analysed to derive average measured resolving power for a given telescope aperture size and type, with the effect of any central obscuration being noted. It will be interesting to compare this with the Rayleigh and Dawes criterion, which are normally used for point sources such as double stars. We will also see the improvements observers got through tweaking collimation, and the differences in H & V due to diagonals, etc. The results from last year were so good that they were published in the Oct/Nov 2013 issue of **Astronomy Technology Today**. You can download the article from the "Real Science with SCURT" page on the TSP website. We hope this year to add more data to confirm the findings made last year, plus hopefully make some new discoveries.

Astro imagers

Measuring your telescope and CCD set up performance using the SCURT requires a little extra care since the sampling of the CCD can give misleading results. If you have optimised your system for deep sky imaging it is probably that the ccd pixel size will determine your resolving power and not your telescope. In this case as the size of the bar targets gets similar to the CCD pitch, strange effects will happen (called *aliasing*). The image below illustrates an example of this effect where the 2nd element in group 1 looks more like it has 2 bars than 3.



If your system has been optimised for planetary or similar high resolution imaging tasks, then this aliasing effect shouldn't be visible and your images will be similar to the case for visual observers shown above.

If your CCD Pixel scale is better than half the typical resolving power of your telescope, then you may like to try and measure the MTF (Modulation Transfer Function) of your system. I will be able to advise on how to do this. You will need some software that can measure brightness at various parts of the bar target image. Maxim DL, AstroArt, Photoshop and Paintshop Pro are all suitable but others may work too.

Keith Venables FRAS

TSP - SCURT Target sheet

Converts observed Target Number (Group & Element) to Bar spacing in arc seconds

Upper Field (assumes 897 yds / 820m & 10 degrees off axis)

Lodge field observers use:

Horizontal Bar table as is, Vertical Bar multiply by 0.95 or use Excel spreadsheet!

Horizontal Bars	Element	Group -4	Group -3	Group -2	Group -1	Group 0	Group 1
	1	4.02	2.01	1.01	0.503	0.252	0.126
	2	3.59	1.80	0.90	0.448	0.225	0.112
	3	3.19	1.60	0.80	0.399	0.200	0.100
	4	2.85	1.43	0.71	0.356	0.178	0.089
	5	2.53	1.27	0.63	0.317	0.158	0.079
	6	2.26	1.13	0.57	0.282	0.141	0.071

Vertical Bars	Element	Group -4	Group -3	Group -2	Group -1	Group 0	Group 1
	1	3.96	1.98	0.99	0.496	0.248	0.124
	2	3.54	1.77	0.88	0.442	0.221	0.111
	3	3.15	1.57	0.79	0.393	0.197	0.098
	4	2.81	1.40	0.70	0.350	0.176	0.088
	5	2.50	1.25	0.62	0.312	0.156	0.078
	6	2.23	1.11	0.56	0.278	0.139	0.070

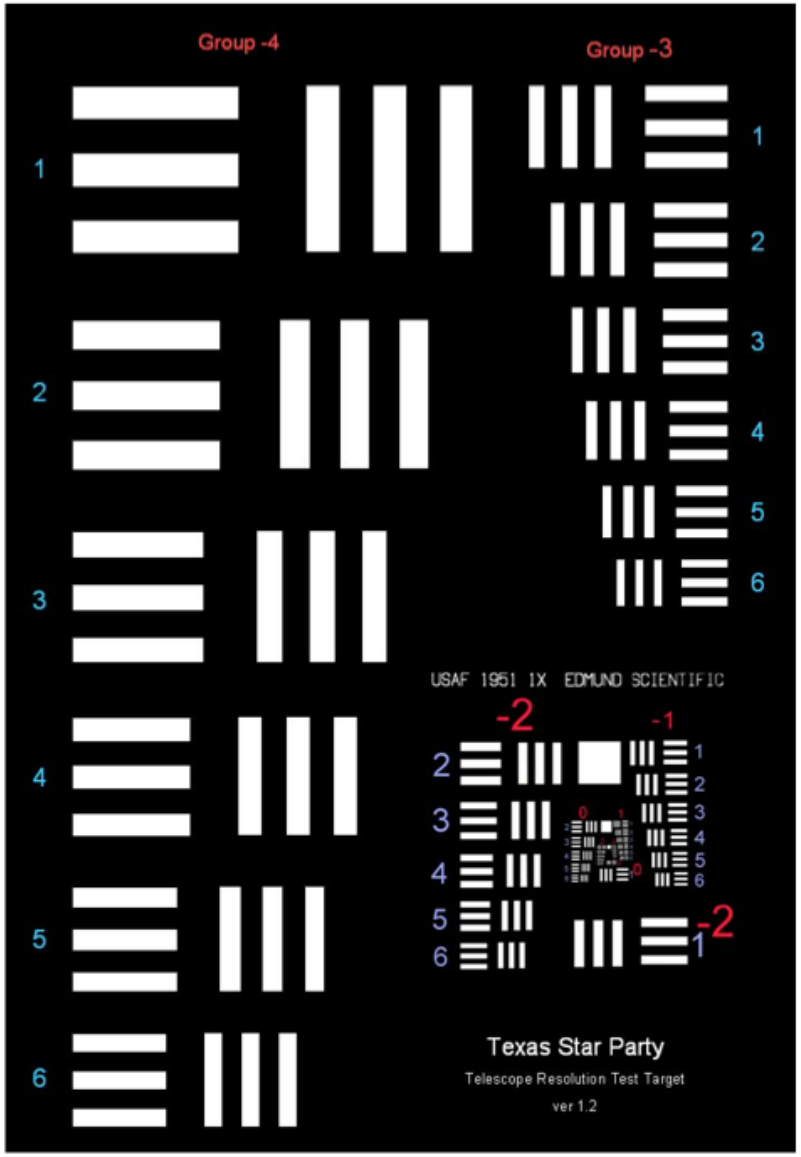
Middle Field (assumes 744 yds / 680m and on axis to target)

Horizontal & Vertical Bars	Element	Group -4	Group -3	Group -2	Group -1	Group 0	Group 1
	1	4.85	2.43	1.21	0.607	0.303	0.152
	2	4.33	2.17	1.08	0.541	0.271	0.135
	3	3.85	1.93	0.96	0.481	0.241	0.120
	4	3.44	1.72	0.86	0.429	0.215	0.107
	5	3.06	1.53	0.76	0.383	0.191	0.096
	6	2.73	1.36	0.68	0.340	0.170	0.085

South Field (assumes 875 yds / 800m & 20 degrees off axis)

Horizontal Bars	Element	Group -4	Group -3	Group -2	Group -1	Group 0	Group 1
	1	4.13	2.06	1.03	0.516	0.258	0.129
	2	3.68	1.84	0.92	0.460	0.230	0.115
	3	3.27	1.64	0.82	0.409	0.205	0.102
	4	2.92	1.46	0.73	0.365	0.183	0.091
	5	2.60	1.30	0.65	0.325	0.162	0.081
	6	2.32	1.16	0.58	0.289	0.145	0.072

Vertical Bars	Element	Group -4	Group -3	Group -2	Group -1	Group 0	Group 1
	1	3.88	1.94	0.97	0.485	0.242	0.121
	2	3.46	1.73	0.87	0.432	0.216	0.108
	3	3.08	1.54	0.77	0.385	0.192	0.096
	4	2.75	1.37	0.69	0.343	0.172	0.086
	5	2.44	1.22	0.61	0.306	0.152	0.076
	6	2.18	1.09	0.54	0.272	0.136	0.068



TSP SCURT Record Sheet

Hand this form to Keith Venables in Cabin 6, or email a copy of this form to kv@astrokeith.com

Telescope Owner	
Location (field and nearest power cord tag ID)	
Scope type	
Aperture	
Focal Length, or F number	
Central Obscuration diameter	
Maker (state if ATM)	

		1st		2nd		Best Results	
		After first collimation		Enter what you changed		Enter what you changed	
		H	V	H	V	H	V
Scope Owner	Target [Group,Element]						
	Resolution [arcsec]						
1st friend	Target [Group,Element]						
	Resolution [arcsec]						
2nd friend	Target [Group,Element]						
	Resolution [arcsec]						
3rd friend	Target [Group,Element]						
	Resolution [arcsec]						
Average	Resolution [arcsec]						
Eyepiece	Type						
	Focal length						
Date & Time							